Infrastructure Investment News and Business Cycles: Evidence from the VAR with External Instruments

Etsuro Shioji (Hitotsubashi)
Acknowledgement

Research for this work has been funded by

• MEXT through the Hitotsubashi Institute for Advanced Study (HIAS)

• Grant-in-aid for Scientific Research
  – A-17H00985
  – C-15K03418
  – C-18K01605

• Nomura Foundation.
Objective

Propose a new approach to tackle the “Fiscal Foresight” Problem
Main idea

Estimate the effects of a “News Shock” to public investment

= Changes in the public’s perception about the future course of the policy.
How can it be done??

• Utilize the **daily** indicator of public investment news shocks by Shioji & Morita (2017), which combines:
  – **Newspaper** analysis.
  – **Stock market** response to the news.

• Incorporate this into the **VAR with External Instruments (VAR-IV)** as the instrument.
Structure of presentation

1. Introduction
2. News Indicator: details
3. VAR with External Instruments (VAR-IV)
4. Results
5. Conclusions
1. Introduction
Why Public Investment?

• Always a subject of heated debate in Japan.

• And... suddenly, also in the US! (since late 2016...)
Difficulty in estimating the impact = “Fiscal Foresight” Problem

Most fiscal policy measures are pre-announced.
Our previous paper:

How can we make unobserved expectations observable?
Literature (1) News-based approach


• Drawback = No sense of magnitude or surprise
Literature (2) Stock based approach

• **Fisher & Peters (EJ 2010)**
  – Excess return on four large military contractors in the US.

• **Drawbacks =** They are *Contaminated* signals.

  – Excess returns of the *Construction Industry* for Japan.
  – “Purified” measure based on SVAR.
Our previous paper combined the two!

• **Excess returns** of *individual* construction companies **on the news dates.**

• Advantages:
  
  – Produces a **single time series.**
  
  – It reflects the **magnitudes of the surprises.**
  
  – Daily data -> **less contaminated.**
This paper:
How should we utilize this indicator?

VAR with External Instruments!!
2. News Indicators
[1] News Analysis side: List of FP events


2. Reconstruction Budget after the Great East Japan Earthquake.


4. Natural Disasters (three earthquakes and a tunnel collapse).

5. Future Sports Events (Nagano, World-cup, Tokyo)


Identified 38 FP events; 159 dates.
[2] Stock market side

• Original data: Construction industry’s 177 firms, listed on Tokyo Stock Exchange (1\textsuperscript{st} or 2\textsuperscript{nd}), at some point between 1974 and 2014.

• Returns = log difference of the close price.

• We regress them on the Market (TOPIX) return to obtain excess returns.

• Are they really informative? Let’s see...
Excess returns by firm

(a) Great East Japan Earthquake (March 14-15, 2011)

Ranking based on the total market value as of 2012 (if present).
(b) Sasako Tunnel Failure (December 3-5, 2012)
(c) IOC gives the Olympics 2020 to Tokyo (Sept 9-11, 2013)
(d) FIFA gives World Cup 2002 to Korea/Japan (June 3, 1996)
(e) “Shiwake” (Nov 10-27, 2009)
How do we combine the two sides?

• Take a simple average?
• But it may reflect all sorts of things.

• Instead, we take advantage of within-industry heterogeneity.

• From here, data is limited to 76 firms that existed throughout the period 1990-2014.
Dependence on Public Investment

= Share of Public work in Total (as of 2000)
Cross-group heterogeneity?
Example from a big “news” event...

Great East Japan Earthquake (March 11, 2011)
sum of excess returns, March 14-15

HIGH gov dependence group (>34%)

LOW
IOC announces Tokyo to hold the Olympics Games

sum of excess returns, Sept. 8-10, 2013

HIGH gov dependence group (>34%) vs LOW
Two stock market indices

• **Stock Mkt Index 1** = “High – Low”
  
  = (Avg of Upper Half) – (Avg of Bottom Half)

• **Stock Mkt Index 2** = “G-factor”

  – Extract 5 common factors -> **Rotate** them!
  
  – **Target rotation**: Select a rotation which gives the closest factor loadings to... (see next page)
## Target for rotation

<table>
<thead>
<tr>
<th></th>
<th>(1) Industry-wide Factor</th>
<th>(2) Home Builders Factor</th>
<th>(3) G-Factor (Gov. Dependence)</th>
<th>(4) Electric Facilities Builders Factor</th>
<th>(5) Plant Builders Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-sized Contractors</td>
<td>1</td>
<td>0</td>
<td>0/1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Big Four Contractors</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Home Builders (all big)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Electric Facilities Builders</td>
<td>1</td>
<td>0</td>
<td>0/1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Plant Builders</td>
<td>1</td>
<td>0</td>
<td>0/1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Stock Mkt Index 1 & 2 (and 0), Cumulative

0 Mean Excess Returns

1 High - Low

2 G-Factor
News indicator (1 & 2 and 0)

Defined as

(News dates)*(Stock mkt index 1 or 2 or 0)
News indicators (daily)

News 0: based on the Mean Excess Returns

News 1: based on "High-Low"

News 2: based on "G-Factor"
News indicators (quarterly aggregates)

News 0: based on the Mean Excess Returns

News 1: based on "High-Low"

News 2: based on "G-Factor"
3. VAR-IV analysis
VAR-IV


• Survey paper by Stock and Watson (NBER-WP24216, January 2018)

• Identification without exclusion restrictions.
Identifying assumptions

• IV is correlated with the true shock contemporaneously.

• IV is orthogonal to the other types of shocks
VAR-IV: 2 variables, 1 lag example

\[ Y_t = A Y_{t-1} + \nu_t \]

\[ \nu_t = B \varepsilon_t \]

\[ Y_t \equiv \begin{bmatrix} y_{1,t} \\ y_{2,t} \end{bmatrix} \quad B \equiv \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \quad \varepsilon_t \equiv \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix} \]
VAR-IV, continued

Assuming invertibility,

\[ Y_t = C(L)B\epsilon_t \]

where \( C(L) = (I - AL)^{-1} \)

...then we just need to know the first column of \( B \)!

Suppose we are just interested in the first shock...
Suppose we have an instrument $Z_t$ which satisfies

\[ E\varepsilon_{1,t}Z_t = \alpha \neq 0 \]

\[ E\varepsilon_{2,t}Z_t = 0 \]

Assumption 1: “relevance”

\[ \mathbf{E}v_tZ_t = \begin{bmatrix} b_{11}\alpha \\ b_{21}\alpha \end{bmatrix} \]

Assumption 2: “exogeneity” (wrt the other shocks)

Normalize to equal 1. We can focus on $b_{21}$. 
VAR-IV, estimation

**Step 1: IV stage**

Using $Z_t$ as the instrument, estimate:

$$y_{2,t} = b_{21} y_{1,t} + d_1 y_{1,t-1} + d_2 y_{2,t-1} + b_{22} \varepsilon_{2,t}$$

get $b_{21}$

**Step 2: VAR stage**

Estimate the reduced form VAR:

$$Y_t = A Y_{t-1} + \nu_t$$

get $\hat{C}(L) = (I - \hat{A}L)^{-1}$
VAR-IV, Impulse responses

Compute the $h$ period ahead Impulse Response Function as:

$$\text{IRF}_h = \hat{C}_h \begin{bmatrix} 1 \\ \hat{b}_{21} \end{bmatrix}$$
Our case: Use the news indicator as an IV

• Our news variable = **Captures only a part of shocks** to expectations about future policies.
  – But it is (I think) **correlated with true shocks to expectations**.
  – And it is (I think) **uncorrelated with the other types of shocks**.
VAR-IV with 5 endogenous variables

• $X_1$ = Stock Mkt Index 1 or 2 (or 0)
• Construction orders from the public sector (top 50 companies)
• Nominal Public Investment (SNA)
• Public Investment Deflator (SNA)
• $X_5$ = One of the macro variables (GDP etc.)

• Details
  – All in log differences except for the news variables.
  – # of lags = 4
  – Dummies for the 3 major earthquakes & Consumption tax hike.
$X_1 = \text{“Stock Mkt Index 1”}, \ X_5 = \text{Real GDP}, \ IV = \text{News 1}$
X1 = Stock Mkt Index, X5 = Real GDP,
IV = News

G-Factor to an FP Shock

Orders-Big50 to an FP Shock

IG-Nominal to an FP Shock

IG-Deflator to an FP Shock

GDP-Real to an FP Shock
For comparison:

\[ X_1 = \text{Stock Mkt Index}, \quad X_5 = \text{Real GDP}, \quad IV = \text{News} \]
7. Summary
• What we have done:
  – Proposed a new way to estimate effects of an anticipated shock to public investment.
    • Combine stock market info and news.
    • Use VAR-IV

• The identified shock has a positive and significant impact on GDP.
  Impact elasticity = 0.2-0.3
  → Impact multiplier = 2-6! (too large?)
Thank you!
Your comments welcome!
Appendix 1
Extended list of fiscal news dates

Sorry, this part is in Japanese!
1. 緊急経済対策

• Fukuda & Yamada (2011) 日付
  – 1990年-2010年の間に15回の経済対策（ただし公共事業が重要でなかったものを除く）が発動された。それらから63の財政出動（または支出上積み）の日付を特定。
  – 92, 93(×2), 94, 95, 98(×2), 99, 00, 08(×3), 09(×2), 10.

• 我々は2010年以降にリストを拡張
  – 2012年11月 (野田政権、5日付)
  – 2013年1月 (安倍政権「第2の矢」、7日付)
  – 2013年12月 (安倍政権、5日付)
  – 日付の選定は日経電子版に基づく
2. 震災復興予算

- 補正予算、2011年度中に3回 (1・2次＝菅政権、3次＝野田政権、計11日付)
- 基本方針（2011年7月、全体の予算規模を決定、3日付）
- 予算規模の大幅拡大（2013年1月、安倍政権、4日付）。

- 日付の選定は日経電子版による
3. 国政選挙
（公共事業に関する方針が大きく関わったもののみ）

1. 衆議院2009年8月（民主党政権、「ダムから人へ」）
2. 参議院2010年7月（与党民主党敗北）
3. 衆議院2012年12月（自民勝利、安倍政権へ）
4. 参議院2013年7月（自民勝利、ねじれ解消）
   • 投票日前と後、それぞれ2日ずつ
   • 追加：野田首相による解散宣言、2012年11月（＋その後2日間）
4. 災害

1. 阪神淡路大震災、1995年1月
2. 中越地震、2004年10月
3. 東日本大震災、2011年3月
   • それぞれ、災害当日＋3営業日の各日付についてダミーを生成
   • 阪神淡路と東日本については、損害額推計の公表された日についてもダミーを生成

4. 笹子トンネル崩落事故、2012年12月
   • 事故当日＋2営業日の各日付についてダミーを生成
5. スポーツイベントの開催決定

• 長野五輪、1991年6月
• 日韓W杯、1996年6月
• 東京五輪、2013年9月

• それぞれ、ニュースがあってから3営業日の各日付についてダミーを生成
6. 「負の」財政イベント

・ 橋本改革、1996年 (3日付)
・ 小泉改革、2001年 (3日付)
・ 民主党「仕分け」、2009年 (18日付)

・ 日付の選定は日経テレコンによる
Appendix 2
Factor loadings
Factor 1

Factor loadings

More gov dependent

Less gov dependent

1926 1929 1822 1846 1805 1899 1835 1814 1881 1803 1819 1947 1834 1825 1964 6366

1929 1926 1822 1846 1805 1899 1835 1814 1881 1803 1819 1947 1834 1825 1964 6366

More gov dependent

Less gov dependent

57
Appendix 3
More IRFs
(X1= High-Low)
X5 = Real consumption
X5 = Real Business Investment
X5 = GDP Deflator
X5 = Nominal GDP